



Do Local Anesthetics Containing Epinephrine Affect Blood Pressure in the Elderly?

Yaşlılarda Epinefrinli Lokal Anestezikler Kan Basıncını Etkilermi?

Dental Local Anesthesia and Blood Pressure in the Elderly

Ayşe Hande Arpacı¹, Berrin Işık², Merve N. Kadioğlu¹, Ali Hantash Abu Hantash¹, Ayegül M. Tüzüner Öncül¹
¹Ağız, Diş ve Çene Cerrahisi AD, Ankara Üniversitesi Diş Hekimliği Fakültesi,
²Anesteziyoloji ve Reanimasyon AD, Gazi Üniversitesi Tıp Fakültesi, Beşevler, Ankara, Türkiye

Özet

Amaç: Dental tedaviler sıklıkla lokal anestezi altında gerçekleştirilmektedir. Yaşlılar ve komorbid hastalığı olanlarda lokal anesteziklere eklenen vazokonstriktörlerin istenmeyen etkileri olabilir. Bu çalışmada yaşlı hastalarda dental tedaviler sırasında epinefrinli lokal anestezik uygulanmasının kan basıncı üzerine etkilerinin değerlendirilmesi amaçlanmıştır. **Gereç ve Yöntem:** Çalışmaya diş çekimi yapılan 479 hasta (yaş; 67.37±6.62) dahil edildi. Hastaların demografik özellikleri, mevcut sağlık durumları ve kan basıncı değerleri lokal anestezi uygulamadan önce ve uygulamadan 5 dk sonra kaydedildi. Hastalar Grup I (n=272) 40 mg artikain/0.012 mg epinefrin (Ultracain® D-S Forte), Grup II (n=196) 40 mg artikain/0.01 mg epinefrin (Maxicaine FORT), Grup III (n=6) 40 mg artikain/0.006 mg epinefrin (Ultracain® D-S) ve Grup IV (n=5) 40 mg artikain/0.005 mg epinefrin (Maxicaine) olarak 4 gruba ayrıldı. İstatistiksel analizler SPSS 20.0 kullanılarak yapıldı. **Bulgular:** Araştırma kapsamına alınan toplam 479 olguda en sık hipertansiyon ve diyabet saptandı. Tüm gruplarda işlem sonrası kan basıncı değerleri işlem öncesinden yüksek bulundu. **Tartışma:** Yaşlı hastalarda dental tedaviler için uygulanan epinefrinli lokal anestezikler klinik açıdan önemli kan basıncı artışına yol açmama birlikte; bu hastalarda detaylı bir sorgulama yapılması ek hastalıkların ve komorbid hastalıkların bilinmesi morbiditeyi azaltabilir.

Anahtar Kelimeler

Dental; Lokal Anestezik; Epinefrin; Yaşlı; Kan Basıncı

Abstract

Aim: Dental procedures are often performed under local anesthesia. Vasoconstrictors added to local anesthetics might have unwanted effects in the elderly and in patients with comorbid diseases. The aim of this study was to evaluate the effects of local anesthetics containing epinephrine on blood pressure in elderly patients undergoing dental procedures. **Material and Method:** The study included 479 patients (age, 67.37±6.62) who underwent tooth extraction. Patient demographics, current health conditions, and blood pressure values were recorded before local anesthesia and at 5 minutes after anesthesia administration. Patients were divided into 4 groups: Group I (n=272) received 40 mg articaine/0.012 mg epinephrine (Ultracain® D-S Forte); Group II (n=196) received 40 mg articaine/0.01 mg epinephrine (Maxicaine FORT); Group III (n=6) received 40 mg articaine/0.006 mg epinephrine (Ultracain® D-S); and Group IV (n=5) received 40 mg articaine/0.005 mg epinephrine (Maxicaine). Statistical analyses were performed using SPSS version 20.0. **Results:** A total of 479 patients were included in the analysis. Hypertension and diabetes were the most frequently reported comorbidities among these patients. Blood pressure values after administration of anesthesia were higher than those recorded before the procedure in all groups. **Discussion:** Local anesthetics containing epinephrine are not associated with a significant increase in blood pressure in elderly patients undergoing dental procedures. Obtaining a detailed clinical history may reduce the risk of procedure-related morbidity.

Keywords

Dental; Local Anesthetics; Epinephrine; Elderly; Blood Pressure

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Corresponding Author: Ayşe Hande Arpacı, Oral and Maxillofacial Surgery, Ankara University Faculty of Dentistry, Beşevler, Ankara, Turkey.

T.: +90 3122965575 F.: +90 3122135474 E-Mail: handarpaci@yahoo.com

Introduction

Dental treatments are often performed under local anesthesia. Although many studies have been performed, there is still no consensus about the effects of the use of anesthetics with vasopressors during dental surgery in elderly patients. On the other hand, the literature also emphasizes that the dose of the epinephrine added to the local anesthetic must be kept below 0.04 mg for patients with severe cardiovascular disease, while in healthy patients the maximum dose must be 0.2 mg [1-5].

It has been proven that local anesthetics containing epinephrine cause a slight increase in heart rate and on systolic and diastolic blood pressures in healthy humans. However, there are conflicting results regarding the cardiovascular side effects of local anesthetics containing epinephrine in patients with systemic health problems [6-9]. Although there is no difference in the use of local anesthetics containing vasoconstrictors between healthy elderly and younger patients, it has been reported that a reduction in the dose and cautious treatment is required for the former group [1]. Furthermore, in patients aged over 60 years, problems related to the cardiovascular system, including hypertension (HTN) and coronary ischemia, are frequently observed [10,11]. The American Heart Association (AHA) reports the prevalence of hypertension (male/female, respectively) as 52/52% in individuals aged between 55 and 64 years; 63.9/70.8% in those aged between 65 and 74 years; and 72.1/80.1% in those aged 75 years and over [10].

In addition to the fact that a significant number of elderly people may be unaware of their HTN, an increase in blood pressure is also expected during dental treatment due to fear or anxiety [11,12]. Dental surgical procedures can generate disturbances in many patients who develop psychosomatic changes during treatment. The stress generated by pain, anxiety, and distress can cause changes in blood pressure and heart rate. Subjects with HTN are part of a special group of patients because these individuals are more likely to experience the complications of hypertensive crises, such as angina, heart attack, and stroke (ischemic or hemorrhagic) [11].

During our literature review, we did not encounter many studies assessing the effect of local anesthetics containing epinephrine on hemodynamic status in elderly patients. Therefore, we aimed to evaluate the effects of local anesthetics containing epinephrine used during dental treatment on blood pressure in patients over 60 years of age who were scheduled for tooth extraction.

Material and Method

The study was conducted with 479 patients ranging in age from 60-89 years who required simple tooth extraction. After obtaining the approval of the ethics committee, the research was scheduled between the dates of 01/03/2012 and 01/03/2013 to include patients aged over 60 years who applied to the Oral and Maxillofacial Surgery Clinic of the Ankara University Faculty of Dentistry for dental treatment and were indicated for simple tooth extraction. Patients were divided into 4 groups: Group I (n=272) received 40 mg articaine/0.012 mg epinephrine (Ultracain® D-S Forte); Group II (n=196) received 40 mg articaine/0.01 mg epinephrine (Maxicaine FORT); Group III (n=6) received 40 mg articaine/0.006 mg epinephrine (Ultracain® D-S); and Group IV (n=5) received 40 mg articaine/0.005 mg epineph-

rine (Maxicaine).

The age, gender, existing systemic health problems, and medications of the patients were recorded. Patients were taken to a quiet environment to rest for 15 minutes in a sitting position before the dental procedure and systolic and diastolic blood pressures (SBP and DBP) were measured (MEC-2000 Mindray®). These values were recorded as SBP before the process (SBPBP) and DBP before the process (DBPBP). The patients were then taken to the dental unit and infiltration of local anesthetic was performed. Blood pressure was measured again at 5 minutes after administration of local anesthetic and the values were recorded as SBP after the process (SBPAP) and DBP after the process (DBPAP). When adequate anesthesia was ensured, tooth extraction was performed.

Patients whose extraction took longer than 20 minutes and those who had complications were excluded from the study. Anesthetic agent used and total anesthesia doses were recorded.

Statistical Analysis

The statistical evaluation was performed with SPSS 20.0 and the data were presented as mean \pm standard deviation (SD), range (min-max), or n (%). Statistically significant differences were identified by p-values of <0.05 .

The normality of the distribution was determined by applying the Kolmogorov-Smirnov test to the measurable parameters. For variables showing normal distribution in the comparison between groups, Kruskal-Wallis test was used for independent groups and the Mann-Whitney U-test was used in case of differences. Paired-t tests were used in the comparison between the first measured intra-group values of the blood pressure measurements.

Results

The data of 479 patients were included this analysis. Eleven patients were excluded from the study because the extraction lasted longer than 20 minutes. No significant differences were found between the age, body weight and gender of the groups. The mean (\pm standard deviation) age of the patients was 67.37 \pm 6.62 years (range 60 to 89 years), the mean (\pm standard deviation) weight was 75.97 \pm 9.11 kg, gender range was male/female: 254/225.

Among all patients, SBPAP and DBPAP were significantly higher than SBPBP and DBPBP.

Comorbidities of the patients who applied for dental treatment, in order of frequency, included HTN (n = 183), HTN plus diabetes mellitus (DM) (n = 72), and DM (n = 49). The list of the comorbid diseases in order of frequency is presented in Table 1.

When blood pressure values were compared according to the anesthetic agent used, SBPBP and DBPBP values were similar, but a significant difference was found between SBPAP and DBPAP values and the measurement before the procedure was significantly higher in Group II than in Group I, while the post-procedure measurement in Group II was significantly higher than in Group I and Group IV ($p < 0.05$, Table 2).

SBPAP and DBPAP were significantly higher than SBPBP and DBPBP in Groups I and II, while pre- and post-process measurements were similar in Groups III and IV (Table 2).

When comparing SBPAP and DBPAP to SBPBP and DBPBP ac-

Table 1. Distribution of comorbidities, all patients

Comorbid conditions	n (%)
Hypertension	183 (38.2)
Healthy	125 (26.1)
Hypertension+Diabetes Mellitus	72 (15)
Diabetes Mellitus	49 (10.2)
Asthma	16 (3.3)
Mitral valve prolapse (MVP)	11 (2.3)
Revised bypass surgery	8 (1.7)
Thyroid cancer	5 (1)
Rhythm disorder	3 (0.6)
Goiter+diabetes insipidus (DI)	2 (0.4)
Other (depression, Cushing's, epilepsy, lymphoma, chronic myelogenous leukemia)	5 (1.0)

Table 2. Pre-and post-process blood pressure values in all groups [mean \pm SD, (range)]

Group	I (n = 272)	II (n = 196)	III (n = 6)	IV (n = 5)	p
SBPBP (mmHg)	131.61 \pm 17.24 (90–220)	133.49 \pm 19.20 (90–180)	133.33 \pm 12.1 (120–150)	126.00 \pm 5.48 (120–130)	0.455
SBPAP (mmHg)	137.85 \pm 18.35+ (90–220)	137.86 \pm 19.89+ (100–195)	133.33 \pm 15.05 (110–150)	134.00 \pm 8.94 (120–140)	0.963
DBPBP (mmHg)	79.95 \pm 12.16 (50–110)	84.74 \pm 15.64* (40–130)	83.33 \pm 15.06 (60–100)	72.00 \pm 10.95 (60–80)	0.009
DBPAP (mmHg)	82.06 \pm 13.24+ (50–120)	87.14 \pm 16.81*+ (60–130)	80.83 \pm 13.57 (60–100)	72.00 \pm 10.9& (60–80)	0.011

+, p < 0.05 (compared to intra-group values before the process)

*, p < 0.05 (compared to Group II)

&, p < 0.05 (compared to Group II)

SBPBP, systolic blood pressure before process; SBPAP, systolic blood pressure after process; DBPBP, diastolic blood pressure before process; DBPAP, diastolic blood pressure after process

According to comorbid diseases, we detected significantly higher after-process values in patients without disease and in those with DM and HTN+DM. In patients with asthma, HTN, and mitral valve prolapse (MVP), only the SBPAP values were significantly higher than those before the process, while the diastolic measurements were found to be similar (Table 3). In patients with other comorbidities (depression, Cushing's, epilepsy, lymphoma, and chronic myeloid leukemia), there were no significant differences between the before- and after-process values.

Table 3. Pre-and post-process blood pressure values by comorbid disorder [mean \pm SD]

	SBPBP (mmHg)	SBPAP (mmHg)	DBPBP (mmHg)	DBPAP (mmHg)
Healthy (n = 125)	128.58 \pm 16.43	133.62 \pm 17.39+	80.63 \pm 13.51	82.80 \pm 12.91+
DM (n = 49)	130.10 \pm 16.01	135.71 \pm 16.55+	79.12 \pm 9.33	82.82 \pm 11.74+
HTN (n = 183)	135.12 \pm 16.74	140.28 \pm 17.42+	83.63 \pm 13.76	84.97 \pm 15.33
HTN+DM (n = 72)	139.05 \pm 20.48	145.02 \pm 22.75+	85.38 \pm 15.57	88.96 \pm 18.13+
MVP (n = 11)	117.28 \pm 19.54	125.91 \pm 19.08+	74.09 \pm 17.72	75.00 \pm 17.75
Asthma (n = 16)	129.38 \pm 24.62	134.25 \pm 21.56+	79.38 \pm 18.06	80.63 \pm 15.69
Thyroid cancer (n = 5)	120.00 \pm 15.81	123.00 \pm 20.49	74.00 \pm 8.94	74.00 \pm 13.42
Dysrhythmia (n = 3)	133.33 \pm 11.55	136.67 \pm 15.28	76.67 \pm 5.76	75.00 \pm 13.23
Bypass (n = 8)	127.00 \pm 8.14	135.25 \pm 14.06	76.57 \pm 11.92	81.71 \pm 6.87
Goiter + DI (n = 2)	115.00 \pm 7.07	129.00 \pm 15.55	75.00 \pm 7.07	75.00 \pm 7.07

+, p < 0.05 (compared to intra-group values obtained before the process)

DM, diabetes mellitus

HTN, hypertension

DI, diabetes insipidus

Discussion

Elderly individuals, defined as those aged 65 years and older according to the World Health Organization (WHO) or those aged

60 years and older according to the United Nations, constitute an important part of the population. It is predicted that the number of elderly people, which was 400 million worldwide in the year 2000, will reach 1.7 billion by the year 2050. As the analysis of the yearly distribution of population in different age groups in Turkey revealed that the rate of population in the 15–60 age group was meaningfully higher than that of 65 years of age and over we focused our study on the 60 years of age and over [13]. Therefore, treatment approaches to older patients are gaining more and more importance, and the present study included 479 patients over the age of 60.

HTN is the most frequently encountered disease in elderly people who are admitted to dental clinics all over the world [11, 14]. In the present study, among the 479 included patients, HTN and other cardiovascular diseases were the most common disorders reported, while only 125 patients reported no comorbidities (Table 1).

The limitations in our study only systolic and diastolic blood pressures was evaluated before and after the procedure. Parameters concerning hemodynamic were not evaluated. Our goal is to evaluate these comprehensive parameters in another study.

Dental procedures are often performed under local anesthesia, and articaine, lidocaine, and mepivacaine are the most widely used anesthetic agents [2,15].

The duration of anesthesia with vasoconstrictor-free local anesthetics in the oral mucosa is very short due to its liberal blood supply. Therefore, in the practice of dentistry, vasoconstrictors are added to local anesthetic agents in order to increase the depth and the duration of anesthesia. In addition, vasoconstrictors may reduce the risk of toxic effects, and they contribute to hemostasis. The most commonly preferred vasoconstrictor is epinephrine, usually in a dose of 1:50.000; 1:100.000; or 1:200.000 [1,5,7,9]. The effect of epinephrine is dose-dependent, and it is a drug with a narrow confidence interval [16]. Insufficient doses of epinephrine in local anesthetics lead to inadequate pain control and poor hemostasis, which can cause dissatisfaction for the patient and physician. On the other hand, an excessive dose of epinephrine may cause unwanted cardiovascular or other effects [9,11]. Two cases have been reported, in patients aged 52 and 35 years, in which cardiac arrest occurred during dental treatment after local anesthetic infiltration containing epinephrine between 0.065 and 0.075 mg. Similarly, it was reported that after the administration of local anesthetic containing epinephrine between 0.60 and 0.80 mg, two patients, aged 43 and 80 years, developed myocardial infarctions, and in one case, a 70 year-old patient developed atrial fibrillation after receiving 0.023 mg of epinephrine [8]. The selected dose of epinephrine in dentistry should be within the range of 0.02–0.2 mg [7]. In the current study, the doses of epinephrine ranged from 0.012 to 0.144 mg, and no severe cardiac side effects were observed.

In dental anesthesia, local anesthetic with epinephrine reaches a maximum level in the blood at approximately 3 to 6 minutes

after injection. Therefore, the blood pressure measurements in the present study were performed at 5 minutes after administration of the local anesthetic. In all the patients, the SBPAP and DBPAP values were significantly higher than the pre-process values. Chaudhry et al. [14] evaluated blood pressure in hypertensive patients at the 2nd and 5th minute before and after the injection of a local anesthetic. They reported that in a group whose blood pressures were 160–179/100–109 mmHg (referred to as 2nd stage HTN) before the injection, a reduction in SBP values was observed in the 2nd and 5th minute after injection of local anesthetic, and in all of the hypertensive patients, a decrease in DBP was observed after the injection. Silvestre et al. [17] compared the average blood pressure in patients with controlled HTN before a procedure, in the 3rd minute after injecting a local anesthetic, and in the 3rd minute after the procedure was completed. The authors observed differences between the pre- and post-procedure SBP values in patients who received epinephrine/anesthetic combinations versus those without vasoconstrictors. Similar to the other studies in the present study, blood pressure values were higher after administration of anesthesia. We believe that the reason for this is the use of local anesthetics containing epinephrine as a vasoconstrictor.

After an injection of a local anesthetic containing epinephrine, α - and β -adrenergic receptors in the cardiovascular system are activated, and this activation can lead to the acute hypertensive crisis, myocardial infarction, and arrhythmia. Drug interactions may occur in patients receiving medical therapy. For example, β_2 receptors are generally blocked in patients using β -blockers, and these may cause a hypertensive crisis because of unopposed α_1 vasoconstriction [5,8,16]. Bader et al. found that local anesthetic with epinephrine caused a small, statistically non-significant increase in SBP and DBP in uncontrolled hypertensive patients compared to healthy volunteers [6], and in 1964, the American Dental Association and the American Heart Association announced that vasoconstrictors in local anesthetics were contraindicated in patients with cardiovascular disease [9,18].

In the literature, it is reported that in patients with mild to moderate cardiovascular disease, local anesthetics with epinephrine are tolerated very well [6,19]. In our study, we did not encounter cardiac symptoms or other side effects, even in the patients who were treated with a maximum dose of 0.144 mg epinephrine (6 ampules of Ultracain DS-fort®).

The local anesthetic agent used and the amount of included epinephrine can also affect blood pressure values [2,11]. In our study, the pre-process and post-process averages of the SBP measurements between the groups according to anesthetic combination were similar, while significant differences were detected between groups in DBP values before and after anesthesia administration. The pre-process measurements were significantly higher in Group II than in Group I, while post-process values were significantly higher in Group II than in Group I and Group IV. In Group II, there was an increase in the DBP at 5 minutes after anesthetic administration according to the value of the DBPBP, which was significantly higher than in the other groups.

Matsmura et al. found significant increases in SBP and DBP in 40 patients between the ages of 19 and 74 years after the in-

jection of 2% lidocaine containing 1:80.000 epinephrine. They reported that this increase was more significant in middle-aged and older patients, and they related this to the difference between regulation of the autonomic nervous system in these patients and in younger individuals [20]. Regardless of the preferred dose of epinephrine, we found higher SBPAP and DBPAP values in patients aged 60 years and over compared to the pre-procedure values. This increase was statistically significant in Groups I and II, in which higher dose of epinephrine were used, compared with the other groups.

The increase in heart rate and blood pressure after the adrenergic activation by epinephrine are undesired cardiovascular side effects. Inpijn et al. have reported that after injection of 2% lidocaine containing 1:80.000 epinephrine, a more evident increase in blood pressure occurred in hypertensive patients compared to normotensive patients, and the same dose of local anesthetic led to arrhythmias in 7.5% of the hypertensive patients [21]. Hersch et al. reported that the increase in pulse and SBP related to articaine with 1:100.000 epinephrine was greater than that associated with an articaine/1:200.000 mixture [22], while Daublander et al. reported that an articaine/1:200.000 mixture caused fewer sympathomimetic effects than articaine/1:100.000 [4]. In the present study, we think that differences in values recorded before and after the process occurred because the selected local anesthetic in Group I and Group II contained higher amounts of epinephrine than in the other groups.

We also found that the SBPAP and DBPAP values were significantly higher than the pre-process values in patients with DM or HTN+DM than in patients with other comorbid conditions. In patients with asthma, HTN, or MVP only, SBPAP was also significantly higher than the pre-process values, while diastolic values were similar. We believe that this was related to cases of HTN that were not under treatment and that it was associated with the dental treatment of these hypertensive patients.

The finding that significant differences were not observed between SBPAP and DBPAP values in the group of patients without comorbidities may be attributable to the lower rate of awareness of HTN in the general population [10,11]. The significant elevations in blood pressure pre- to post-process in patients with known DM and DM + HTN may be associated with damaged vascular structures and with impaired adrenal response [23-25]. The significantly higher values in patients with DM are related to the extreme response to adrenergic activation after the deterioration of the structure of the vasculature due to the endocrine derangement [23,24], and this suggests that the significantly higher values in patients diagnosed with HTN are associated with the blood pressure being controlled by antihypertensive treatments [6]. It is reported that a reduced dose of local anesthetics containing epinephrine is safe due to the extended duration of the effect. In the present study, only a minimal increase in SBP was observed among patients with asthma, and no problems were encountered [18].

To conclude, local anesthetics containing epinephrine are not associated with a significant increase in blood pressure in elderly patients undergoing dental procedures. Obtaining a detailed clinical history may reduce the risk of procedure-related morbidity.

Competing interests

The authors declare that they have no competing interests.

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